



SOUTH AUSTRALIAN SOCIETY of MODEL and EXPERIMENTAL ENGINEERS INC.

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On the cover of this Bulletin is Rohan leading the charge on the 7 ¼ “ track, followed by Ainsley on the Hunslet.

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EDITORIAL

Communication

Did you know you might be a Ferroequinologist?

Next time you are at SASMEE, you will be surrounded by them. They are not hard to spot. A quickening of the pulse, a faraway look – every time a train is close by.

The dictionary describes a Ferroequinologist as:

Noun: Literally "the study of the iron horse." (ferros = iron, equine = horse, -ology = study of)

1. The study of the history of railroads and railroad trains, especially for the purpose of model railroading.

2. What a Railfan practices.

A railroad museum, or perhaps even a model railway club may be thought of as an Institute of Ferroequinology.

PRESIDENT'S REPORT.

Ian Thomas

Greetings Everyone,

We have had a lot of milestones and events happen this year

Constitution. This was voted in by the membership and approved by the Office of Consumer and Business Services. The new Constitution has been streamlined into a more readable form and has taken lessons for the Covid 19 pandemic to make it more flexible.

Regulations. In conjunction with the Constitution, new Regulations have been approved by the membership. Many documents, subordinate to the Regulations, such as work instructions, forms etc, have been drafted and posted on the SASMEE Website.

Workshop. The drawings have been completed and submitted to the Structural Engineer for Certification. Expressions of Interest have been circulated to prospective tenderers. Building Approval is still pending. At this stage it is anticipated that building may commence later in this year.

A lot of preliminary work, particularly with services has been undertaken by club members. This has been necessary as the existing workshop was the central distribution point for all of the services. The re-aligned track to the 5" turntable is complete.

With the winding down of the Covid pandemic, public attendances have started to pick up, but have yet to achieve their pre-pandemic level.

In May the Club conducted its first formal Training Day. This was very successful and it is intended to run these on a regular basis. A Members' Booklet has been produced and will be progressively issued to Members.

We had a boat day which was well attended and successful

We had a successful interclub run and many visitors from other clubs turned up

We have a whole lot of junior members join this year which is great to see some young faces at the club.

7 1/4 locomotives U33 has been refurbished and is nearly back in service the Hunslet is almost therewith aa minor issue to be fixed when I return from USA.

I look forward to an exciting new year with the completion of the new workshop and signalling

Lastly, I would like to thank all members that participated in all the working bees and club events to make this club successful.

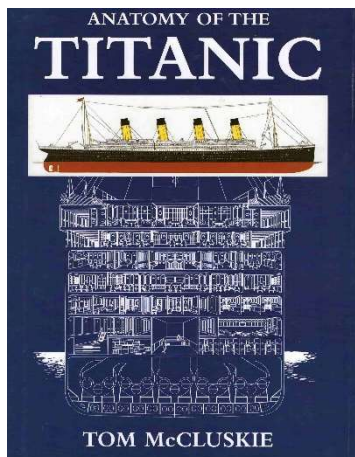
Best Regards, Ian Thomas. President. 2022/2023

IN THE LIBRARY

Max Shuard

The library is open from 7:00 to 7:45 on General Meeting nights. Also, I generally attend the public run days and Wednesday working bees, so if you are looking for something, please just ask.

Book of the Month



Anatomy of the Titanic. Tom McCluskie.

Everyone has heard of the Titanic. That luxury liner that sank on its maiden voyage, with a huge loss of life. But what about the ship itself? Why did it sink? It turns out, that if it had hit the iceberg head on, it probably would not have sunk. It was powered by conventional piston engines, not turbines as were the faster ships of the day. So, it wasn't trying to claim the Blue Riband for the fastest passage across the Atlantic. Much greater priority was given to timely departure and arrival. It is often

criticised for its inadequate number of lifeboats, yet it had nearly twice the number mandated by the Board of Trade at the time.

McCluskie's book examines the ship itself. The design, construction and operation. Safety and comfort were priorities in the development of the ship. And it was never claimed to be unsinkable by either the designer or constructor.

A very interesting insight into an historical event that everyone "knows" and has an opinion. Highly recommended.

IN THE WORKSHOP

Tool Feature

Over the last couple of years, a number of interesting tools have been featured. Tools, sometimes for a single job, or sometimes for a particular function. Most, but not all, are home made. So, if you have anything you have made or

acquired to solve a particular problem, could you let me know and it will be featured for all members to see? Ed.

TECHNICAL MATTERS

1/10 Scale Railway Dynamometer car

A joint project by Allan Wallace and John Lyas

Description and Operation



Introduction

Project History

The idea of making a 1/10 scale dynamometer car was suggested to me by John Lyas in 1994. John had sourced information on a South Australian Railways prototype, and I addressed the problem on how to do the instrumentation. The instrumentation system was first fitted temporarily fitted to my 5"g passenger truck, so that we could run the system at the 1996 Australian Convention of model engineers, being held in Adelaide. Soon after, John completed the coachwork and subframe, and I made temporary 3-piece bogies. Later John made proper passenger type bogie frames, using the wheelsets from the original bogies.

Overview of Railway Dynamometry

Railway engineers have always been concerned to get the maximum work out of their locomotives for a minimum consumption of fuel. An important part of railway engineering has been to experimentally measure the work done by an engine so that an objective measurement of efficiency can be obtained.

Collecting real data in this way lets the engineer compare locomotives (and their crews) and make better decisions regarding locomotive design, operation and management.

The purpose of a dynamometer car is to measure the output of a locomotive at the drawbar while the engine is in real service. This is in contrast to fixed dynamometer installations where the locomotive is mounted on a laboratory test bed and real driving conditions must be simulated.

The primary quantities measured are the drawbar pull (called “force” in this document), and the speed of travel. Knowing the maximum drawbar pull is of some immediate interest because this determines the mass of the train that the engine is capable of pulling. Also, the instantaneous power output can be derived from these primary measurements, because $\text{Power} = \text{Force} * \text{Speed}$.

However, the more fundamental quantity desired is the work done over a given run, because this can be divided by the energy content of the fuel consumed, and produce an energy conversion efficiency for the locomotive operating under those conditions. Work done is measured in units of energy, and is calculated by integrating (“adding up”) the instantaneous power readings. For example, if the power is measured at fixed time intervals, then the energy output is

$\text{Energy} = \text{Sum of } (\text{Power} * \text{TimeInterval})$ calculated over the entire time of the run.

This is not the only way to calculate the work done. Traditional dynamometer cars used a moving paper chart to record force and speed, but the chart paper was advanced by connecting the drive to the wheels of the car. Pens moving laterally across the paper plotted the force and speed, driven by mechanical instrumentation. In other words, the chart movement was distance based, not time based. This meant that the engineers could use graphical techniques to measure the area under the force curve, which is an alternative method of calculating the energy output. i.e.

Energy = Sum of (Force * DistanceStep) = (Area under the Force vs Distance curve) calculated over the entire distance of the run.

In this scale model dynamometer car, we have adopted the same distance-based scheme because it is more meaningful to view a graph of force versus distance. This is particularly so when the train may be stopping during the run: when the train stops, the data logging stops, which avoids the need to store unnecessary data.

To summarise, the dynamometer car logs the force and speed versus distance travelled, and from that information the power levels and work done can be determined. Secondary statistics which can be obtained are quantities such as maximum force, power and speed, and if additional fuel measurements are made then overall thermal efficiency can be found.

Units of measurement

Traditional locomotive engineers usually calculated in Imperial units. The software for this dynamometer car is written with standard metric (SI) units. The following table compares the units used in both systems

Quantity	SI metric unit	Imperial unit	Conversion
Force	Newtons	Pounds Force	1 lbf = 4.5 N
Distance	Metres	Feet	1 ft = 0.305 m
Energy (or Work)	Joules	ft lb	1 ft lb = 1.37 J
Speed	Metres/Second	Miles per hour	1 mph = 0.45 m/s
Power	Watts	Horsepower	1 hp = 746 W

In the metric system:

Joules = Newtons * Metres
(work = force * distance)

Watts = Joules/Second = Newtons * Metres / Second
(power = work/time = force * speed)

In Imperial units:

Ft lb = feet x pounds
(work = force x distance)

Horsepower = 550 ft-lb/sec = lb * mph * 5280/3600
(power = work/time = force * speed)

Note that the consistent SI metric system requires no conversion factors. Consequently calculation is simpler and less prone to error.

In the more recent software versions, I have converted the displayed velocity units from m/s to kph, as most people find this more meaningful. Furthermore, the calibration force can be input in kgf rather than Newtons, since the reference spring balances used for calibration are in kg.

Data Collection System

Overview

The data collection system comprises:

Electronic sensors mounted on the car to measure force, speed and distance.

An electronic system to interface the sensors to a computer. This system amplifies the signals, performs analog to digital conversion, and communicates with the laptop computer.

A laptop computer, to interrogate the electronics system, read and convert the measured quantities, display the results, store the data, retrieve and print stored data, and manage the sensor calibration.

Software custom written for the laptop computer.

A power supply system, consisting of a car battery and an inverter.

The car is set up by connecting the above modules and turning on the computer. A menu based program lets the user test and calibrate the sensors, start and stop recording, and store or retrieve data.

The car is placed directly behind the engine or tender at the head of the train so that it records the force at the drawbar. While the train running, the computer screen displays a mimic of a scrolling paper chart. At the end of the run, the data is stored on disk.

At any time, the data can be retrieved and displayed on screen, or printed out.

In 2005 an external load cell was made, and it can be used as an alternative to the internal load cell. The external load cell substitutes for a connecting

link approximately 150mm long, with 6.5mm holes for pins. It is normally installed behind the tender of the locomotive under test, so that the driver can choose to use their normal driving truck and have their mass included in the train. This is fair for smaller engines (3.5" g and 5" g), but most 7.25" g engines are driven from the tender and the driver's mass is unavoidably included with the locomotive and not the train. The external load cell is on a long flying lead, so the dynamometer car can be placed anywhere in the train.

The Energy-based Logging Method

Instead of drawing a graph on a paper chart, the computer stores numbers and plots graphs on the screen. In this model, numbers are recorded every 32 turns of the wheels, which is about 7.5 metres. We call this a section.

Thus, for every section of approximately 7.5 metres, the computer program needs to store a force and a speed. However, there is a complication. While the locomotive is traversing any section, the force and speed will vary. Unfortunately, it is invalid to simply log the average force and speed.

To illustrate this, imagine that the train is starting from rest. The force could be highest when the speed is lowest, and when the train is moving, the locomotive could be coasting with zero force. In this case, the true energy output from the locomotive will be much less than the energy that would be calculated from $\text{AverageSpeed} * \text{AverageForce}$, and the dynamometer car would be overestimating the true work output.

This problem is overcome by calculating the work done three times per second, instead of just once per section. A running sum of the work done is maintained until the section is complete. This could take only a few seconds at full speed, or thousands of seconds if the train stops within the section. However, we are now making the much better assumption that the force and speed are approximately constant for 333 milliseconds, rather than for a whole section. This gives us a very accurate measure of true work done.

Because the program calculates the section work done with such good precision, it makes sense to store this value instead of force. After all, the main quantity of interest in dynamometry is the work output, not the force or the speed. The program also stores the time taken to complete the section.

Thus, the computer really stores work done (joules) and time taken (seconds) for every section, rather than the force and speed.

However, we wish to display the equivalent of a paper chart showing force and speed, just like the old dynamometer cars. To do this, the program can work backwards from the stored section work done and section time taken. The number of completed sections is known from the number of values that have been stored, so the total distance information is available.

To calculate the effective mean force, speed and power of a section for plotting purposes, the program does this:

$\text{AverageSectionSpeed} = \text{SectionLength} / \text{SectionTime}$
(metres per second = metres / seconds)

$\text{AverageSectionForce} = \text{SectionWorkDone} / \text{SectionLength}$
(Newtons = Joules / metres)

$\text{AverageSectionPower} = \text{SectionWorkDone} / \text{SectionTime}$
(Watts = Joules / seconds)

This may sound a little convoluted, but it results in a precise measurement of work done under all conditions, whether the train is accelerating, braking, stopped or even reversing! Such a technique is more practical for model engineering, where it is inconvenient and perhaps unsafe to try to maintain constant running conditions on the club track.

It is important to recognise that the average section speed, force and power are derived values which relate to the true work done rather than to the simple (and misleading) time-averaged quantities.

Working in Reverse

It has been described how the program stores work output data every 7.5 metres after adding up the work done for every second of duration that the train takes to complete the section.

It is assumed that the force and speed are constant over each sampling interval (1/3 second), so that the work done in that time interval is given by:

$\text{WorkDone} = \text{Force} * \text{Speed} * \text{TimeInterval}$.

By convention, Speed is positive when the train moves forward, and the Force is positive when the locomotive is pulling. Thus, the WorkDone will be positive.

Should the engine push the train backwards, then both the Speed and the Force change sign. The two negatives cancel out and the WorkDone is again positive. Hence the work output of the locomotive is correctly measured in both directions.

However, from experience with efficiency trials there is no need to cater for backwards running, and the software has been set up to zero any negative velocity. This is called "Positive-only mode" and it can be turned off by the user if desired. The Positive-only mode also zeroes any negative drawbar force, so if the locomotive is used for braking the train, the work done tally is not debited with work done by the train on the locomotive.

Effects of Braking

Normally the locomotive does work on the train by pulling it forward. Should the train push the engine while still running forwards, the force goes negative, and the WorkDone will also go negative (if Positive-only mode is off). The train is now doing work on the engine, and the program is deducting from WorkDone in the current section.

For normal coasting with the regulator shut, this deduction will be small, but (if Positive-only mode is off) it does unfairly penalise the measured output of the locomotive. If the locomotive is used for braking, then the penalty may be severe and the true efficiency of the engine will be underestimated.

However, if the train is braked, slowing the engine, then the engine's kinetic energy is accounted for as positive WorkDone on the train, because the Force and Speed are still both either positive (forward motion) or negative (reverse motion).

For better accuracy then, all braking should be done by the train, not the locomotive, whatever the direction of motion.

Additional Statistics

The discussion above on the energy-based logging method applies to the precise measurement of output work done. It does, in fact, throw away actual maximum and minimum values of force, speed and power, which would be of some interest also. The program therefore keeps these separately, updating them every 333 milliseconds as required.

Specifications

The design maximum force is 1000 N in either direction.

The design maximum velocity is 18 kph or about 6 m/s.

The capacity of the program storage is currently 2000 datapoints, corresponding to about 16 km of running. This is quite adequate for the usual 30 minute efficiency trial run, which will usually cover about 5 km.

Sensors and Calibration

Force

Force is measured by a strain gauged load cell. The built-in internal load cell was originally used in electronic scales. It has a force measurement range of 60 Newtons (6kgf), while the drawbar pull could be up to 1000 N. A low-friction mechanical lever with a mechanical advantage of approximately 1/16 is used to reduce the drawbar pull to a level suitable for the load cell. The external load cell is home-made from a piece of thin-wall brass tubing, with a strain gauge bridge and end fittings compatible with the common rolling stock clevises with ¼" pins.

In both load cells, the drawbar is effectively solid.



Figure 1 Internal load cell

Figure 2 - CAD model of the 16:1 lever pivot shaft used for internal load cell. Drawbar connects via a yoke with bearings to the small (eccentric) stubs, and the shaft mounts in bearings on the intermediate diameter. Load cell is actuated from the projecting arm.

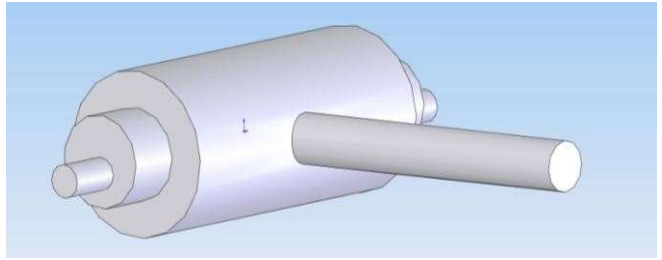


Figure 3 - External load cell. Used as the draw link behind the engine tender



To eliminate the signal noise generated by vibrations and rough track conditions, the electronic signal is low pass filtered to a cutoff frequency of about 1 Hz. This has the effect of averaging the force signal over the sampling period and produces very consistent results under all running conditions.

The force is calibrated by applying a known force to the drawbar, from a standard weight or spring balance.

To minimise errors due to mechanical friction in the internal linkage, the lever has been precision machined and uses ball bearings on all pivots. The mechanical hysteresis is smaller than the resolution of the A/D converter, which is about 0.3 Newtons.

Speed

Speed is measured by a DC tacho generator, belt driven from a non-braked wheelset. The generator used is an ERNI DC minimotor, producing about 4.3V at 20 kph. In May 2009 it was discovered that the calibration factor varied by several % as a function of speed. This was traced to the effect of the drive torque causing the belt to flex and creep. The drive torque varies linearly with speed when the DC generator is loaded by a fixed resistor. The effect was minimised by using a voltage follower op amp in the circuit to make the load resistance effectively infinite. Its effect has been virtually eliminated by a feature in the software which auto-calibrates the tachometer during the run, using the wheel rotation counter for a reference. Most trial runs are done at an approximately consistent speed and the errors would be insignificant. As with the load cell, the signal is low pass filtered to 1 Hz cutoff frequency.

The speed can be calibrated by following a routine written into the software which calibrates it from a known distance travelled and a known time. The distance is derived from the wheel revolution counter, and the time from the computer clock. The calibrations are written to disk file (see later for management of calibration data).

In addition to the calibration routine just mentioned, the tachometer is recalibrated continuously on the run. Note that the tachometer is technically redundant, because we can determine speed from the wheel rotation and the time. The reason for using the tachometer in addition to the wheel sensor goes back to the original hardware adopted at the beginning of the project. This hardware did not have the capacity to pass timing events back to the computer: the computer could only poll the hardware at 1 second intervals. Thus it was impossible for the wheel rotation events to be detected accurately in time by the computer in order to work out the speed. The tachometer was introduced to provide a continuously-available analog speed signal for the computer. Obviously, if I were starting with today's interfaces, the architecture would not use the tachometer. But it is worth noting that the tachometer allows one to detect reverse motion, whereas a simple encoder (without quadrature outputs) does not detect reverse rotation.

The automatic calibration keeps two tallies of distance travelled, one from the tachometer, and one from the wheel sensor. The tallies run only during non-stop running above a prescribed minimum speed. When a prescribed non-stop distance (e.g. 100 metres) is reached the tachometer gain is adjusted by the ratio of the two tallies, and the tallies are then restarted from zero. In this way, even if the speed calibration is wrong, it is corrected accurately

after 100 metres. This automatic tachometer calibration effectively maintains accuracy of the work-done tally.

The resolution of the speed signal is approximately 0.006 m/s.

Distance

Distance is measured by an optical sensor which counts turns of the wheels. This signal used to tell the program when a section (defined as exactly 32 turns, or approximately 7.5 metres) has been completed. It is calibrated by measuring the wheel diameter with a vernier caliper, and entering the value into the program.



Figure 4 - Belt-driven tachometer and optical axle rotation gap sensor (including 13 years of accumulated dirt)

Time

The time base is derived from the built-in clock on the laptop computer. No calibration is required.

In the early days, the standard MSDOS computer setup updated the system clock 18.2 times per second, which gave us a clock resolution of 55 milliseconds. I understand that this has been superseded, but whatever it is, the work done accuracy is related to the clock resolution as a proportion of the time taken to complete a section (7.5 m) so it is of no concern.

Calibration files

A file named "DefaultCalibs.cal" is maintained in the same directory as the program. The program reads this file when started, loading the calibration values into memory. If the user performs a recalibration the file can optionally

updated. Also, the tachometer calibration in memory will be updated by the automatic calibration. This revised value can be stored to the default calibrations too, but it is hardly necessary because it will be corrected during a run.

When the dynamometer data is stored at the end of a run, the current calibrations are stored with the data, and if the data is loaded back into the program for review, the associated calibrations come with it, also for review. An appropriate warning will pop up if non-default calibrations are left in memory when a new run is started. One can then open the Calibration screen and click "Reload Defaults".

The calibration data provides for two alternative load cells and it is most important to tell the program which load cell is in use. This is done under the "Setup" menu item. Added protection against getting this wrong is provided by a pop-up screen whenever the Run menu item is invoked. It advises the operator which one has been selected, before new data is taken.

Settings file

Another file named "dyn.set" is used to record program options which are not calibrations.

1. Comport (now redundant)
2. Positive-only mode setting
3. Chartwidth (i.e. distance displayed before the chart scrolls)

The user may be prompted to overwrite this file after doing a calibration.

Electronic Hardware

Power Supply

A 12V lead-acid motor car battery is carried. A 12VDC to 240VAC inverter (150W rating) is carried to provide mains power for the laptop computer, and to power the electronics module. An additional 12V gel cell (from a security system) is used by the electronics module, and this is recharged from the 240V supply. The gel cell is redundant now, because the system can run from the 240V, however, it is retained to stabilize the DC supply and to make the system more robust against outages of the 240V. The laptop computer will also continue to operate from its internal battery if the 240V fails. Historically, the 240V is fairly reliable, but on one occasion the exposed car battery leads were

accidentally disturbed, and sometimes the inverter has shut down by its internal temperature sensor.

Analog Interface

Circuit diagrams are given in the appendix. The board holds a number of relatively small circuits required to drive the sensors and return clean, filtered analog voltages of 0 to 10V to the computer interface.

Digital Interface

The original digital interface was a custom made board incorporating an 8 channel analog-to-digital converter chip, addressed by a 6402 UART (Universal Asynchronous Receiver Transmitter), so that the computer could initiate a conversion on a particular channel by transmitting an 8 bit character from its RS232 COM port. When the conversion was complete, the 8 bit converted number was placed in the UART, which sent it back to the computer via the same COM port.

This has been superseded by a commercial USB (Universal Serial Bus) device. It is a cigarettebox-sized plastic enclosure with screw terminals for analog and digital inputs and outputs, plus a USB socket. It is one of the ECONseries economy interfaces made by Data Translation, model DT9812-10V. It was sourced from: Kevin Dowsey 0417 580 709, kdowsey@turnkey-solutions.com.au

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**Figure 5 -
Analog/Digital
interface. Analog
inputs on the left,
USB cable on the
right.**

It accepts analog inputs between -10 and +10V, and converts to 12 bit accuracy at up to 50 kHz, which is well beyond the real requirements for this dynamometer car. As stated above, if I were starting again, I would use the digital input capabilities, but I have not invested the time and effort to do this so the system retains the tachometer-based speed measurement and polled data acquisition of the original design.

Only four of the channels are used, for speed, force, wheel revolutions and battery voltage. The wheel revolution input is a bivalued analog voltage, since it derives from a digital counterdivider. The computer senses when 32 revolutions have occurred by a level transition in the voltage. Two transitions cannot possibly occur in less than the sampling time, so counts will never be missed.

Computer

The original computer used (in 1996) was an IBM compatible laptop manufactured by Sharp, model PC6220. It had a 12MHz Intel 80286 processor, a 20 megabyte hard disk, a VGA monochrome LCD display, and 1MB of RAM. The operating system was MSDOS version 4.

Now any laptop running Microsoft Windows and fitted with USB can be used. I keep an old Toshiba machine for field use.

Software

Overview

The original program was written using Turbo Pascal version 7.0 for DOS. It has since been upgraded and rewritten in Borland Delphi (an object-based implementation of Pascal) version 4. This provides a Microsoft Windows interface, with the conventional menus, icons and controls.

When the program starts it checks for the presence of the USB interface. If it is not found, the user is told that inputs are simulated. Raw data is generated by a random number generator, but otherwise the operation of the program is unaffected. This is convenient for demonstration and training, and makes the program stand-alone on any computer. Foreseeably, the hardware is not always plugged in when reviewing the data files and preparing reports.

The File menu is used to save and load data files, and also to copy the main graphical image to clipboard for pasting into reports.

The View menu is a simple toggle, between the main graphical display, and a text-based summary of the run so far. It can be pressed during data acquisition if desired, without interrupting the data stream.

The Setup menu provides for calibration and testing of the sensors, as well as a toggle to select which load cell is in use. Note that each load cell has its own calibrations and whichever one is in use must be calibrated. The calibrations of both are stored, and switched in depending on the selected load cell.

The run/stop menu starts and stops data acquisition. You can stop acquisition, and restart with an option of clearing the log or not.

The Efficiency menu is a simple calculator enabling you to input the quantity of fuel used, and its calorific value. The program will calculate the thermal efficiency from the current work done tally. Typically, this is used at the end of a trial when the coal consumption has been determined. The values are stored with the rest of the data when it is Saved under the File menu.

The About menu displays version and identifying information.

The Help menu displays a text-based help file with the basic “how to” steps enumerated.

Program Technique

Time-based Sampling

Approximately three times per per second, the computer reads the four sensor signals (force, speed, wheel pickup, battery voltage), converts the raw signals to SI units, and calculates, for the last sample's worth of motion:

Speed	(Direct, m/s)
Force	(Direct, N)
Time since last reading	(from system clock)
Power level	(watts = speed * force)
Distance travelled	(metres = Speed * TimeStep)
Work Done	(joules = force * distance travelled)

It then stores the following quantities:

Maximum speed	(keeps the largest value found so far)
Maximum force	(keeps the largest value found so far)
Maximum power	(keeps the largest value found so far)
Cumulative section time	(last value + TimeStep)
Cumulative distance	(last value + distance travelled)
Cumulative work done	(last value + Work Done)

The stored values are updated every sample until the distance sensor signals that a section is complete, after 32 wheel turns.

End-of-section Processing

When a section is completed, the cumulative values from the above list are added to the permanent record, and new accumulations are started.

The only complication is that the end-of-section will occur within a sampling period, rather than neatly on the boundary between two measurement periods. In other words, the last 1/3 second of running straddles the section boundary. This is handled by splitting the work done in the sample between the two sections. Of course, one can argue that splitting the last 1/3 second's worth of work done is hardly warranted, and it could justifiably be dumped into either section with no error in the total work done. The strategy originated when the sample period was limited by hardware to 1 second, when it was justified to obtain a more faithful plot of drawbar pull at high speed.

The computer works out the split by comparing the cumulative distance with the known section distance. The cumulative distance will generally slightly

exceed the section length, because the end-of-section sensor switched some time in the last second. The extra distance therefore belongs to the new section.

Thus the cumulative distance and work done in the last sample can be apportioned between the last and the current sections. The statistics for the finished section are completed, and the cumulative values for the new section are initialised with the values left over from the last sample.

End-of-run processing

At the end of the run, the data can be written out to a named file on disk. The data comprises:

- Header information, such as a short description, date and time,
- Calibration values used to convert sensor values.
- Run Statistics, such as maximum power, average speed etc.
- List of logged section energies and transit times.

Routine Operation

Acquiring data

When the system has been set up and calibrated, routine operation is relatively simple.

- Turn the power switch on (see the red light blinking).
- Turn on the computer. After bootup, start the program.
- If desired, review the setup options on the SETUP menu, and verify the sensor signals using Setup/Test.
- Prepare the train.
- Select RUN when ready.
- Preferably, monitor the data on the run to check that the system is operating (see below), but this is optional.
- When the run is finished, stop recording.
- If the coal consumption was measured, enter the mass under the Efficiency menu item. This will calculate the thermal efficiency, and the data will be stored.
- Select FILE, then SAVE, entering a name when prompted.

Reviewing data

To see data which has been previously stored:

- Select FILE, then LOAD. Choose a file from the list.
- Use the zoom and pan controls (top left of screen) as needed.

Monitoring on-the-run

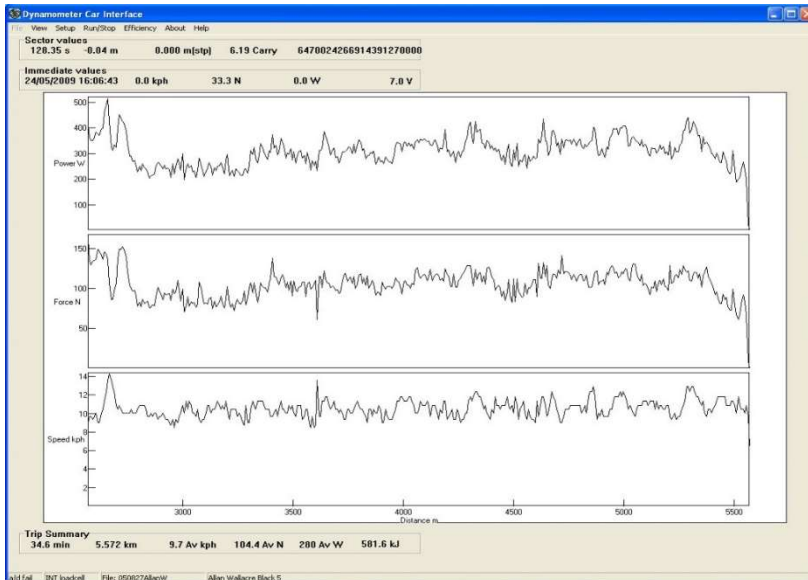


Figure 6 - View of running screen

The system does not require intervention during the run unless there is a failure (e.g. flat battery). I recommend covering the laptop computer keyboard and screen to protect it from water, dust, oil, cinders and bright sunlight.

The top panel of the running screen labelled “Sector values” is of little importance to the user: I used it for validating end-of-section processing and might turn it off one day.

The Immediate Values are valuable for verifying the sensor signals on the run. The battery voltage refers to the 12V gel cell, not the car battery, and one can detect when it is charging. Sometimes the locomotive driver might want to know speed or power, and the observer can easily call them out from this panel.

The graphs mimic a scrolling paper chart, as in the prototype dynamometer car. The distance scale is automatic (unlike paper) and the entire run distance is plotted, gradually squeezing up until it exceeds a set distance of, say, 3 km

(which you can set under Setup/Calibrate) and then it begins to scroll. Of course, the entire data record is kept, up to about 16 km (currently). The vertical scales are automatic, adjusting to display maximum and minimum extremes. The charts can be manually scaled and scrolled when the data is reviewed after the run.

If one presses the View menu item, the display is toggled between the graphs and a summary screen. This can be done at any time without interrupting data acquisition. It may be useful for watching the speed calibration automatically adjust.

The Trip Summary panel provides the latest cumulative data of time, distance and work done, plus average speed, pull and power.

In the status panel at the bottom of the screen one can see the status of the interface. “a/d fail” means that the USB interface is unplugged. The load cell is indicated too (INTernal or EXTernal). This is important so that the appropriate calibration constants are in use. Finally, a line of text can be saved with any data file, and this is displayed (if present).

Calibrating force

This is best done under workshop conditions, with a suitable frame to provide a purchase point for a good spring balance, reacting against the car buffer beam. It saves time to connect the two load cells in series, i.e. with the external load cell connected to the dyno car coupler. I use a ratchet strap to adjust the applied force via the spring balance. Since there is a low-pass filter on the force signal, one needs to keep the applied force steady to avoid a transient error.

The program leads you through a two-point calibration procedure, entered via Setup/Calibration/Force. This has to be repeated for each load cell, and it is important to have the correct one selected (under Setup) when doing its calibration.

The final constants are presented to the user for acceptance before being placed into memory for use. If accepted, one is also prompted to optionally record it to the default calibration file, so that it is available for adopting next time the program is started (or defaults are reloaded). A further prompt may occur to enable one to rewrite the settings file too. I usually just click “yes”.

Under Setup/Calibration one can manually edit the gain and offset constants if desired, but this is not normally required.

Calibrating Speed

The wheel diameter is used as the distance reference and it should be accurately measured and entered under Setup. It will be stored in the default calibration file and should rarely need updating.

The speed calibration can be done either on the track, or in the workshop if one arranges for an electric motor to spin the instrumented wheelset at any selected constant speed. Note that the automatic calibration routine is active at all times, and even if the calibration is out it is quickly corrected, transparently to the user. (One can watch the slight calibration adjustments during a run, using the View menu item to toggle the display.) However, it is preferable to start with correct values by following the two-point calibration procedure provided in the software under Setup/Calibration/Speed.

As with the force, one should avoid transient error by establishing steady input values. The first point is taken at zero speed. The second point is taken while running at a moderate steady speed. The software will delay the measurement until a section boundary is triggered, so that an accurate distance can be obtained. Time is taken from the computer clock to calculate speed.

The measurement takes place over one section, and the final constants are presented to the user for acceptance before being placed into memory for use. If accepted, one is also prompted to optionally record it to the default calibration file, so that it is available for adopting next time the program is started (or defaults are reloaded). A further prompt may occur to enable one to rewrite the settings file too. I usually just click “yes”.

Under Setup/Calibration one can manually edit the gain and offset constants if desired, but this is not normally required.

Measuring coal consumed

I consider that this is the most error-prone factor in measuring locomotive thermal efficiency. The reason is that one cannot be precise about reloading the firebox to the same fill state after the run. Typical efficiency trial runs last for 30 minutes, and the mass of coal burned relative to the average mass of the bed on the grate will vary considerably depending on the size of the engine and

its load. Where this ratio is small, the accuracy of the measurement will be small because of the uncertainty in the refill level. It is particularly a problem with large engines running lightly loaded.

The best approach I have been able to implement is to encourage drivers to make their engine work hard according to their capabilities, and then to appoint an experienced independent official to fill the firebox to the driver's preferred depth before the run, and refill to the same level at the end. This requires care and skill to achieve a similar degree of packing and levelling of the firebed each time.

The coal is weighed with electronic scales and a system of buckets and paperwork set up, to maintain a consistent process and documentation.

Results

Using the Efficiency menu item enables one to produce a thermal efficiency figure almost immediately after the run, and it is interesting to watch the list develop and rankings change as a test day proceeds. To date, results taken with this car have ranged from 0.1% to 2.1%, with most locomotives around 1%.

2012 was the last time the Club ran these trials! Time to crank it up again. Watch this space. ED.

CLUB ACTIVITIES

Safety Valve Run

The Safety Valve Run was held on Saturday 29th July. A fairly quite night with about twenty-five members attending. The weather was beautifully clear and calm, with a first quarter moon. The event started at 1300 hrs with dinner at 1800 hrs. With the sun setting at about 1730 hrs, there was plenty of time for night time running.



**Geoff Hall preparing his Maisie,
watched by Matthew Longman and
Safety Officer David Hawkins.**



John Mere with 509.



**SASMEE
by
moonlight!**



Master Chef Bryan with the steaks.



Dinner in the warmth of the Clubroom.

Since SASMEE started participating the Royal Adelaide Show, Bill Coles and Jeff Schaefer have acted as Judge and Steward. Both have now retired from Judging and Stewarding. Many thanks to both for their time and effort over the years for the resounding success of the event. I'm sure there were many proud builders with their models on show and being able to talk to the public and new model makers because of the Royal Adelaide Show.

There are eight exhibits this year. Come past and have a look!

Jacks on Unley

It is not everyday that someone comes to the Club and offers a \$500 donation.

Well, it happened!

Sue, from the Sturt Football Club advised that Jack's on Unley offered a donation each

month to community organisations in the Unley area. The only catch was that a photograph was needed. As you can imagine this caused consternation in the Committee. It was finally decided that Alan Thomas was the most photogenic so he had the honour of accepting the donation from Julie Woodcock.

Jacks on Unley is a Club Bistro offering meals. Details can be found at: <https://jacksonunley.com.au/contact/> So if you are in the area, please drop in.

Now the decision is how to spend the donation. Don't want to just put into the general revenue. Any ideas??



Buy and Sell

This has now been shifted to the SASMEE Website. Under the ABOUT SASMEE Tab. No password required.

If you have anything in the workshop and model engineering area that you would like to buy or sell, please let me know.

Keep monitoring this site. There is a lot of good stuff.

7 ¼ Inch Battery electric locomotive and 4-wheel Driver's Truck



Based on the LMS experiment in Diesel shunting in 1932.

24 volts supplied by 75 A/H deep cycle batteries through a 4QD controller to a 500-watt brushless motor.

Ball race bearings on axles and drive shafts. Case hardened crank pins, meehanite bushes.



Driver's truck rolls on ball races and is panelled in English oak with its own brake system.

The locomotive has an emergency brake, lever operated and a park brake using the wheel brake shoes.

Comes complete with trolleys for both the locomotive and driver's truck.

C'Tec battery charger included.

Asking price \$8,000 ono.

Ring Jeff Schaefer on 08 8298 6927 *Avid readers of the SASMEE Bulletin will no doubt remember this locomotive was featured in an article in the August 2020 edition. Ed.*



7 1/4" Loco. WREN, to a design by Ken Swan.

Built to Ken Swan`s original castings and drawings, the engine which is in running condition has a copper boiler with 4-year certification.

Engine has both a crosshead pump plus a steam pump. A steam take-off for carriage braking operates from the cab. The Bum truck which is braked carries a water supply and a hand pump.

Sale includes a purpose fitted trailer [currently not registered.] adjustable full length transported plus Bum truck mover.

Included are the original drawings, wheel patterns, total fireman`s kit and sundry spares and fittings. Boiler construction photos are available.

The Engine has done minimal running.

Contact Bill on 0466790619

Price is negotiable



0466790619

Genuine Myford lathe universal milling attachment.

Includes clamp bolts and clamps. Condition is as new as only used once.

Asking price \$75

Contact Bill. 0466790619

12 Inch rotary table. Industrial standard, unmarked slotted table. 90:1 ratio. Fully graduated. Construction is "heavy" Asking price \$275. Contact Bill



Up and Running

Since the last Bulletin, Public Run Days were held on the 4th June, 17th June, 2nd July and 15th June, 6th August and 19th August. There was the Safety Valve Run on Saturday 29th July.

Here are some selected details.

The Run Day on the 2nd July had the following activities:

5", 7 ¼"

- | | |
|---------|-------------------------------|
| • 705 | Matthew Longman/David Bryker |
| • Sooty | Rohan Garrard/Ashley Roocroft |

On the 3 ½", 5" track were:

- | | |
|-------------------|-----------------|
| • NSU 57 | Kingsley Martin |
| • 457 | Simon Lindsay |
| • Pugsley | John Bellew |
| • Apprentice | Jake Bott |
| • Mystery Machine | Trevor Hill |
| • Speedie | Allan Wallace |

On the pond were:

- | | |
|--------------------------------|----------------|
| • Cranborne, MPV P1011 | Bob Smith |
| • Curlip | John Foster |
| • Patrol boat P1011 | Jeff During |
| • Chris Craft Corvette | Michael Offler |
| • SASMEE Fast Ferry, Work boat | John Clayfield |
| • Grenadier | Alan Saunders |
| • Swiss Barge, Cabin Cruiser | Malcolm Ambler |

On the Garden Railway

- | | |
|----------------|------------|
| • Thomas, Ruby | Max Shuard |
|----------------|------------|

On the stations were Michael Taliangis, Rachel Brougham and Henry O'Neil.

Bernie Dickinson and Michael Moyse attended the Steam House.

In the Canteen were Mary Homann, Di Watkin and Bryan Homann.

On the gate were David Hawkins and Trevor Morcom.

Ian Thomas was the Safety Officer.

The Run Day on 6th August had the following contributions:

5" 7 ¼"

- | | |
|-----------|-------------------------------------|
| • Sooty | Rohan Garrard/Guard Jackson Hefford |
| • Black 5 | Allan Wallace |
| • 351 | Matthew Longman |

On the 3 ½" 5" track were:

- | | |
|-------------------|-----------------|
| • NSU 57 | Kingsley Martin |
| • 509 | Philip Mere |
| • Clishay | John Lyas |
| • 457 | Simon Lindsay |
| • Daisy | Toni Offler |
| • Mystery Machine | Trevor Hill |
| • Apprentice | Jake Bott |
| • Pennsylvania | John Mere |

Some of the boats on the pond were:

- | | |
|-------------------------------|----------------|
| • Skylight | Michael Offler |
| • Cranbourne | Bob Smith |
| • Cabin Cruiser | Malcolm Ambler |
| • Tubby Tugger, Cabin Cruiser | John Clayfield |

On the Garden Railway

- | | |
|---------------------------|-----------|
| • Great Western (O gauge) | Bob Smith |
|---------------------------|-----------|

- AT & S Big Hauler
- Short Line Railway

Rachel Brougham
Rachel brougham

On the stations were Paul Hefford, Michael Taliangis, Toni Offler, Henry O'Neill, Daniel O'Neill and Ashley Roocroft.

In the Canteen were Mary Homann, Di Watkin Bryan Homann.

On the gate was David Hawkins.

Safety Officer was Max Shuard.

The Run Day on the 19th August had the following activities:

5" 7 ¼"

- Sooty
- 351

Rohan Garrard/Guard Jackson Hefford.
Rachel Brougham

On the 3 ½" 5" track were:

- NSU 57
- 357
- Speedy
- Pennsylvania
- Apprentice
- Jack Junior

Kingsley Martin
Simon Lindsay
Allan Wallace
John Mere
Ainsley Cuthbertson
John Monteodorisio

On the pond were:

- Fire Boat
- North Sea Fisher
- MFV 1567
- Fast Ferry
- Workboat

Mike Turner
Michael Offler
Michael Priest
John Clayfield
John Clayfield

On the Garden Railway

On the stations were Michael Taliangis, Toni Offler, and Henry O'Neil. Bernie Dickinson and Bryan Homann attended the Steam House. In the Canteen were Mary Homann, Di Watkin and Graham Gaetjens. On the gate was David Hawkins. Max Shuard was the Safety Officer.

Meetings

All meetings were held in the club rooms on the second Tuesday of the month.

After the July General Meeting, there was a presentation by Allan Wallace on the Cinder Control from steam locomotives.

Efforts are being made to provide interesting and topical talks after each General Meeting. If you have any ideas, requests (or better still!) offers, please let me know. Ed.

SASMEE PROJECTS

Signalling Works.

Work is continuing on the signal masts and footings. The main work is now setting up the control panel in Fort Knox. This has been complicated by the construction of the new workshop. Some temporary works will be required during the construction period.

Workshop

The drawings have gone to the Structural Engineer for checking.

Expression of interest documents have been forwarded to seven companies.

The retaining wall is now complete and the top end of the yard is being cleared.

A lot of work has been undertaken in relocating services. Of particular importance has been the rewiring of Fort Knox. Water and compressed air are also being relocated. A temporary switchboard has been erected, taking all of the electrical connections to other facilities out of the existing workshop.

U33.

The hydraulics are still causing grief because of leakage. The bogies have been refurbished and are back under the loco soon. The shell still has to be painted.

Photo shows Ainsley and Michael performing open heart surgery on U33.



Hunslet

Work on the engine and drive chain are complete. Work on the connecting rods and bearings is finished. The locomotive still requires work on the wheels to fix them in place.

Trackwork

The track from the 5" turntable to the mainline has been re-routed to allow for the construction of the new workshop.

SASMEE BUSINESS

New Members

Since the last Bulletin SASMEE has gained these new members:

Dianne Watkin	June 2023
Kyle Delaney-Carter	July 2023
Richard Sanders	August 2023

REMINDERS!!

Food Safety Course

There is a very good food safety training course online at:

<https://dofoodsafely.health.vic.gov.au/index.php/en/>

Anyone involved with the Canteen is encouraged to undertake this course. It covers the basics and gives good advice on food handling for public areas.

Working with Children

And for those who still haven't undertaken their "Working with Children" clearances, these are still necessary, so please get on the case.

You will soon receive some explanatory notes on this issue. It is vital SASMEE has up to date information.

Sign In Requirements

It is a requirement to sign the attendance book whenever you are on site at SASMEE. This is an important requirement of the SASMEE insurance and failing to sign in may mean you are not covered in the event of an incident or accident.

Note that you are now asked to enter the time of arrival and the time of leaving.

So please remember to sign in whenever you are at the park, even if there for only a short time.

ELECTED MEMBERS 2023/2024

Below are listed the elected members.

President	Ian Thomas
Vice President	Bryan Homann
Secretary	Max Shuard
Treasurer	Mary Homann
Asst Treasurer	Trevor Morcom
Safety Co-ordinator	John Bellew
Councillors	Alan Thomas
	Rachel Brougham
	Rohan Garrard
	John Mere

There are a number of non-elected positions required for the running of the club. Below is the list of these positions and the appointees for 2022/23. This list will be updated after the next Committee meeting.

Public Officer	Alan Saunders
Minutes Secretary	David Hawkins
Canteen Managers	Bryan and Mary Homann
Track	Michael Hattersley, Cameron Dicker, Rohan Garrard
Track Signals	Michael Moyse
Coal Monitor	John Mere
Rolling Stock Inspectors	Ian Thomas, John Mere
Boiler Inspectors	Bryan Homann, Simon Huntington, John Monteodorisio, Peter Hoyer, Allan Wallace
Auditors	Graham Gaetgens, Michael Moyse
Fire	Jake Barber
Buildings	Geoff Hall
Rubbish Collection	David Hawkins
Librarians	Mike Turner, Max Shuard
Bulletin Editor	Max Shuard
Pond	Jeff During
Garden Railway	Alan Thomas
Boiler House Manager	Bernie Dickinson
Driver Trainer/Assessors	John Mere, Rohan Garrard
Competent Person AALS	Allan Wallace
Facebook Moderator	Alan Thomas
Workshop Steering Committee	Bryan Homann, Alan Thomas, Max Shuard